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Note comment of Lt Wagner amesall / ALW [D-73]

This describes Lorenz Geraet 1313, two-channel Baudot intercept gear captured by us and now used by our intercept stations.

Wagner: Please look at this
ALW

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[D-73]

The storing relays of this system would be of interest to those envisioning Polygraphic Baudot schemes, constituting a means of overcoming some of the technical difficulties inherent in such systems.

David E Wagner 1st Lt.

~~TOP SECRET~~

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TICOM/D-73

D-73
DF-57
T-706
AMER. TRANS.

D-11
BRIT. TRANS

PROVISIONAL DESCRIPTION AND INSTRUCTIONS FOR USE OF APPARATUS 1313

The attached translation of TICOM document No. 706 was received from A.S.A. Washington under cover of Information Letter No. 33. T. 706 is dated 27th October, 1944.

2. Apparatus 1313 was designed to intercept A2 Teleprinter traffic. In A2 T/P precedure two five unit code messages are transmitted in such fashion that the impulses of each symbol of message I are followed by those of one symbol of message II and finally by two impulses as phase signal for synchronization purposes. Apparatus 1313 separates the incoming messages so that one teleprinter prints only message I and the other only message II.

TICOM
13th June, 1946.

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TOP SECRET

T 706

Provisional Description and Instructions for use of Apparatus 1313. (27 Oct. 1944)

Apparatus 1313 serves exclusively for intercepting A2 teleprinter traffic and may be used for operation with Mark (+) as well as with space (–) current (Arbeits- owie auch Ruhestrombetrieb). The A2 teleprinter procedure transmits two messages in such fashion that, using the familiar five-impulse alphabet, the five impulses of a letter, figure or sign of message I are transmitted successively, followed by the five impulses belonging to message II. Following this come two impulses as phase signal for synchronization purposes. Hence, for the process we require 5 + 5 + 2 = 12 impulses, which are all of the same time length. After sending these 12 impulses the procedure is repeated, there follow five impulses of message I, five of message II and finally two of the phase-signal, etc. Apparatus 1313 separates the incoming messages after it has been brought into synchronization with the transmitter by means of the transmitted phase-signal, so that one teleprinter prints only message I, the other only message II. The normal telegraphic speed for teleprinters is 50 bauds. In many cases, however, it happens that the speed of the sender is lower, say 40 bauds. To enable the teleprinters attached to apparatus 1313 to adjust themselves to such possible variations, Storers (Speicher) are provided in Apparatus 1313 which permit a change of telegraphic speed. The Start-Stop impulses required for operating a teleprinter are added in proper sequence to the five impulses of each message in Apparatus 1313.

Structure of apparatus 1313.
As shown in Fig. 1 the following removable separate units are mounted in a frame and connected electrically by cables in the frame.

1) 60 v stage, see diagram EVSt 1309-203
2) Tube rectifier II, see diagram EVSt 1309-201
3) Tube rectifier I, " " EVSt 1309-200
4) 12 v stage, see diagram EVSt 1309-778
5) Mechanical part, see diagram EVSt 1313-146 and 1309-382
6) Receiver amplifier with regulating device, see diagram DVst 1309-240
7) Storer 1)
8) Storer 2) " " EVSt 1313-147
9) Synchronisation amplifier, see diagram DVst 1309-202
10) Control part, see diagram CVSt 1313-145
(11, 12, 13, 14) Boxes for connecting-cables and replacement parts.

The wiring of the frame may be seen in the diagram CVSt 1313-148
The external current supply for the apparatus is from a 220V ac line, Deviations of ± 10% still permit safe operation.
Other current supply within the apparatus is cared for by the rectifier stages 1-4 according to Fig.1.
The 60v stage contains a dry rectifier assembly. It serves as current source for the holding current circuits of the storage relays and for the circuits of the receiver magnets in the teleprinters.
Tube rectifier II is a stabilized power source. It provides the plate current for the vibrator in the synchronization amplifier, for the receiver amplifier without regulator device, also current for holding circuits of the two receiver relays in the receiver amplifier,

moreover, in the tube rectifier II the grid voltages (biases) are taken off which are required in the several component parts. Tube rectifier I contains two separated rectifiers with adequately planned smoothing filters (Beruhigungsglieder). The first rectifier provides plate current for the last two stages in the synchronization amplifier.and the 3 tubes of the regulator device in the receiver amplifier. The second rectifier delivers plate current for the storage tubes. The 12 v stage contains two separate dry rectifier assemblies. Assembly 1 delivers current for the motor to drive the distributor-discs and the test-sender in the mechanical part. Assembly 2 gives, after careful smoothing, the current for the rotating, magnetically functioning deflection system (Ablenksystem) of the cathode ray oscillograph in the mechanical part.

The Mechanical part. A motor mounted here drives via a set of gears the brushes for two distributor discs, 1 test sender and the magnetically functioning deflection system (Ablenksystem) for the cathode ray oscillograph. The current supply of the cathode ray tube comes from the so-called high-voltage rectifier located above the tube. Also, in the mechanical part are the suppressors for the distributor discs, the storage tube common to the two storers and the armature and field resisters necessary for regulating the speed of the motor. In fig. 2 the screen (Schirm) of the cathode ray tube will be recognized at 1. The setting (tuning) of the brilliance of the Cathode Ray Spot is accomplished at 2 and that of its sharpness at 3. With switch 4 it is possible to switch the motor on and off. Knob 5 serves for regulating the revolutions of the machine to get local synchronization. The receiver-amplifier is a two stage amplifier with a final limiting stage tripped by the lower band of the characteristic curve (?)[Mit einer aus dem unteren Knick der Kennlinie herausarbeitenden begrenizenden End-Stufe.] In the plate current circuit of the last tube lie two polarized relays, the teleprinter and the oscillograph relays. The regulator device contains 3 polarized relays which are excited by one tube each. The grids of these tubes are controlled by 3 segments on one of the distributor discs in the mechanical part. By throwing in the before mentioned 3 polarized relays, which with their contact sides affect the vibrator in the synchronization amplifier, it is possible to influence the frequency in appropriate manner, i.e. to regulate it. In fig. 3 the receiver amplifier has at 1 a meter [selector] swithh (Messschalter) for control of tubes of the receiver amplifier, of the regulator device and the synchronization-amplifier. Knob 2 serves to adjust input voltage. 3 is the input socket for the radio receiver to be connected. At 4 a headset may be plugged in for monitoring. The Storer (Speicher). Apparatus 1313 has two Storers. As already stated, one Storer is associated with each message to adapt the telegraph speed of the teleprinters to that of the transmitter to be received. Each individual impulse of the five-impulse-groups is held in the 5 impulse-relays. The individual relay has two windings, the exciter winding and the holding winding. There are also two other relays whose windings lie in the plate cursent circuit of a tube associated to each relay. The first relay has the function, after the appropriate tube has received on the grid side a short impulse from the distributor, of starting the teleprinter associated with that Storer. Then the teleprinter scans by the aid of its sender, which has been reconstructed for this purpose, the impulse relays of the Storer one after the other. According to the state of the storage relays the proper letter is printed. After the sender

shaft in the teleprinter has made one revolution it locks automatically. This blocking must be released by an impulse to the start-tube or start-relay of the teleprinter in order to print the next letter. The second relay has the function, after the proper tube has received a short impulse on the grid side from the distributor, , of bringing the Storer into a neutral state, i.e. of preparing it to receive a new letter for storage. This is always the case when a letter has been printed by the teleprinter. On the front plate of the Storer is, as shown in fig.4 at 1, a selector switch (Messchalter). By the aid of this switch and a meter in the Control part the exciter currents and holding currents of the Impulse-relays, likewise the tubes for the Start and Clear-out (Loesch) relays can be supervided. Toggle switch (Kippschalter) 2 is provided for receiving enciphered messages. For such reception the switch must be on "Dauerstart-Ein" (Permanent start - on).

The synchronization-amplifier serves to attain local synchronization, in particular between the vibrator frequency of the synchronization-amplifier and the frequency supplied by the generator part of the drive mechanism in the mechanical part. Accordingly the synchronization amplifier also contains a vibrator. The frequency produced in the vibrator can be varied within range of about 500 - 1000 cycles. This range corresponds to a locally synchronizable speed range of the distributor brushes of about 150 - 245 rpm. Since the electrical output of the vibrator is too slight to synchronize the drive mechanism, there is a push-pull final stage (?) (Gegenkontaktend-Stufe) which is connected to the vibrator through an intermediate stage. The ac output from the synchronization amplifier amounts to about 10 watts. Change of the synchronizing frequency is attained byknobs 1 and 2 as shown in fig. 5. With knob 1 the fine setting is made, while the coarse setting is made with knob 2. The toggle switch (Kipphebelschalter) 3 is operated to secure the proper phasing of the apparatus. Control of the four tubes is possible through the meter in the receiver amplifier.

The Control part.

This containe essentially the parts which need to be checked during operation. Furthermore, in this part is mounted the transformer for the heating of all tubes in the apparatus. In fig. 6 at 1 is an instrument for measuring the voltage of the power line. This shows the power voltage when main switch 2 is off. Swithh 2 switches all power supply units on and off, i.e. the whole apparatus. It proved necessary to be able to switch the Storers on and off as desired and toggle switches 3 and 4 are for this purpose. To each switch is associated a warning lamp. 5 and 6, which indicated the state of the Storer concerned.

Switch 7 (Kipphebelschalter) is the meter selector switch. If turned up, instrument 8 shows the currents which must be watched in Storer 1. By turning the Selector switch on the front of Storer 1 all currents can be checked which are shown on the scale of that switch. If switch 7 is on center, then instrument 8 can be used for the currents indicated on the Selector switch scale of the receiver amplifier. When switch 7 is down it permits watching the currents of Storer 2. Toggleswitch 9 is used to cut the receiver-amplifier from the distributor disc, i.e. signals coming from the sender cannot reach the distributor and consequently cannot be printed. This break is especially desired when brief disturbances (Störungen) interfere with the signals coming from the sender. When the disturbances cease switch 9 is thrown from position "FS-bereit" (teleprinter-ready) to "FS-ein" (teleprinter

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local synchronization. The cathode ray tube in the mechanical part serves for recognition of local synchronization. The position of the switch depends upon the manner of operation of the transmitter to be received, i.e. whether with + (Arbeitsstrom) or - (Ruhestrom) current. The center position of the swithh makes possible a thorough check of the apparatus with test text which is produced in the machine and brought to the input of the receiver amplifier instead of the text from the remote station. In this way the entire apparatus may be tested. All in the out leads are at the back of the apparatus. These include power line, ground lead for the apparatus, modulation lead, 2 teleprinter power leads, 2 teleprinter control leads.
Having given a short survey of the individual parts, we shall now explain the way the apparatus functions

Principle of Apparatus 1313.

According to fig. 7 the wireless signals 1 come via the antenna 2 to the radio receiver 3. In the figure the sequence of the impulses is shown as it is in A2 operation. Reading from the right we find therefore at 1 the phase-signal (blue) which is so important for correct synchronization and phasing of the transmission devices.
It consists, as already noted, of two steps of equal length, the first step is an impulse, the second step is blank. This two-step phase-signal is followed by two groups of five impulses belonging to the messages transmitted.

Those of message I are marked red, those of message II green. Then the process is repeated. These impulses come then to the radio receiver 3. They leave this with tone frequency carrier as shown at 4 and are conducted to an amplifier with peak limiter 5 (Höchstwertbegrenzer). Here the signals are amplified, rectified and limited. Finally they excite two relays wired in series. Each relay forms the beginning of a new circuit 6 and 7, where in each circuit the same processes take place (see at 8 and 9). The signals are no longer ac but dc and are conducted via lead 6 to the distributor assembly for evaluation while the impulses of lead 7 are conducted to a Braun tube to be rendered visible. The distributor assembly is driven by a motor 10 which is so arranged that it can be synchronized through lead 11 from a oscillator with power amplifier 12, i.e. the tone frequency which can be set at 12 determines the speed of motor 10 and keeps this constant for a long period of time. Motor 10 through gear-set 13 drives the distributor shaft 14 which in turn bears the brush holders 15 and 16 which with their brushes scan the segments of the stationary distributor discs 17 and 18. Furthermore shaft 14 drives the magnetically functioning deflection system 19 of the Braun tube 20. This Braun tube is especially important because through it one can check visually the essential functions of the apparatus. The A2 procedure is a synchronized telegraphic procedure. In the present case this means that shaft 14 requires the same time for one revolution as the distributor shaft of the remote transmitter. However, this alone is not sufficient inasmuch as the distributor brushes 15 and 16 must also be in phase with the distributor brushes of the remote transmitter. These two essential requirements are easily met with the aid of the Braun tube. First there is a "local synchronization". As the name suggests, two processes must occur in the same rhythm. The thing which sets the tempo in apparatus 1313 is the oscillator 12 with the appended power stage (Leistungsstufe), the part which must adapt itself to the tempo set is the motor 10. Via the lead 11 the rhythm is forced upon the motor in that the so-called synchronization frequency is imparted to the ac part of the motor. This

does not always mean local synchronization of the motor, hence the speed of the machine must be altered on the dc side until the speed of the motor corresponds to the given frequency. In the Control part of the apparatus is a switch "local synchronization" which, when operated, connects circuit 11 to the magnetically functioning deflection system (Ablenksystem) of the Braun tube. This switch is not shown in fig. 7 but it is described fully in the following section. According to the state of local synchronization the pictures on the fluorescent screen (Leuchtschirm) of the Braun tube will vary. Fig. 7 shows the screen picture of an apparatus not in local synchronization. In circuit 11 beats (?) (Schwebungen) occur between the frequency coming from the local rhythm setter (?) (Taktgeber) 12 and that produced by the motor 10. The motor speed must therefore be changed till a picture results like that in fig. 7b. In the case shown, the synchronizing frequency coming from the oscillator 12, is the same then as that from the motor. Any slight change of frequency coming from oscillator will naturally cause a change in the number of revolutions per minute of the motor and hence a change in the speed of shaft 14. Hence, oscillator 12 is expected to maintain a very constant frequency. It is not difficult to determine the speed of the remote transmitter. A corresponding frequency is set at 12. It may be that this frequency will have to be reset later. Such necessity is established if the impulses 9 coming through lead 7 reach the deflection system 19 as shown in fig. 7. Then there results the screen picture shown at 20. As is well known, the phase-signal is sent by the transmitter after every revolution of the distributor shaft. Hence, like all other signals this signal appears in the fluorescent screen picture. In most cases the phase-signal will wander to the left or right in the picture after the initial setting of the synchronization frequency and the attendant establishment of local synchronization. By working the frequency-fine-setting [knob] the frequency is now so changed that the phase signal always appears in the same spot. Once that has been achieved, then the speed of the distributor shaft 14 is the same as that of the remote transmitter.

This condition was, as stated above, the first requisite for operation. Upon looking more closely at the picture in the Braun tube an especially high narrow deflection (Ablenkung) 21 is noted in the upper half of the circle. This mark serves for the setting of the correct phase position. This second requisite for operation is fulfilled when the phase-signal has a well defined position with respect to the mark 21 and indeed it must look as it is shown at 20. The interval between the phase-impulse and mark 21 should correspond to the width of the phase impulse, the distances a snd b in 20 should therefore be equal. By operating a switch in the synchronization amplifier the phase-signal is brought into the position which is shown in screen picture 20 and has just been described as the second requisite for operation.
Once the apparatus is running synchronously and in phase with the remote transmitter the printing of the incoming messages may begin. The signals 1 coming in over lead 6 are led to the distributor disc 17 via the brushes 15. Here the impulses of message I go to the red field, those of message II to the green field, and the two step phase-signals to the blue field. Of each incoming impulse of the message transmissions only a very small part(mid-pulse sensing)(Mittenabtastung) is conducted via lead 22 to the grid of a bube 23. In uncontrolled state the passage of current through the tube is blocked. Only when an impulse reaches the grid can current flow. Since there is a condenser resister assembly in the grid circuit of tube 23, the signals are lengthened and leave tube 23 as shown on lead 24. Through this lead the impulses come via the brush 16 to the actual distributor disc 18. The impulses of message I are distributed within the red field, those

to control the oscillator 12 via lead 25. Through this control procedure, known as regulation, it is supposed to make it possible to equalize small, suddenly appearing changes of speed which originate in the remote transmitter or in apparatus 1313. To distributor 18 come then only the impulses of messages I and II. The leads attached to the several segments of this distributor lead to Storers 26 and 27. There is a Storer for each message. Here the impulse aggregate of the transmitted message is held and the printing of the letter corresponding to the stored impulse aggregate occurs in response to an impulse which is generated on distributor disc 17. Teleprinter 28, therefore, prints only message I, teleprinter 29 only message II. In what follows the process for message I will be described: After distributor disc 18 has passed on the lengthened (gedehnt) impulses (red) via the segment-leads to the storage relays in 26 and operated the relays there, than as soon as the fifth impulse of a group of five has been distributed, on impulse disc 17 at 30 an impulse is generated which goes via lead 31 through the Storer and causes teleprinter 28 to start. Teleprinter 28 now picks up as rectangular impulses the impulses stored in Storer 26, evaluates them and finally causes them to be printed. This would seem to be the end of the matter but there must now ensue another procedure to restore the relays of Storer 26 so that it is ready to receive the next signal of message I and store the same. This so-called clearing (Löschung) of the Storer is accomplished on the basis of an impulse which likewise comes from disc 17. The production of this clearing-impulse results at 32 and via lead 33 this impulse is transmitted to Storer 26. In the period between the transmission of the start-impulse at 30 and of the clearing-impulse at 32 comes the clearing of the Storer 26 by the teleprinter 28. During this time a signal of message II has been stored in Storer 27 by distributor 17 working with distributor 18. At 33 on impulse disc 17 came the start of teleprinter 29 for message II, and at 30 the appropriate Storer 27 was again cleared and made ready to receive the next letter of message II. This process is repeated for each letter, number or sign of both message I and message II.
The next section explains the circuit diagram in all details, including those which here were omitted in the interest of clarity.

How 1313 works (Complete wiring diagram)

In the input lead from the radio receiver lies a choke-condenser unit to keep interference from affecting the receiver. The impulses come first to the switch U 42 in the control part. If the switch is in the upper or lower position, the impulses are switched to the entrance of the receiver-amplifier stages. Rectification is by full wave rectification in Delong circuit, which doubles the voltage. The grid of the next output tube (Endrohr) has such bias that practically no plate current flows. If the rectified amplitudes produce a voltage which reduces the adjoining tube's grid voltage to the permissible grid voltage for operation (ca. 0 volt), then plate current flows and the telegraph relays located in the plate circuit are operated. If the voltage produced becomes so great that a positive grid voltage results, then the working point of the tubes is displaced to the upper bend (Knick) of the (Kennlinie) characteristic curve. The unit then possisses limiting effect. In the plate circuit lie the two telegraph relays R 16 and R 17 (oscillograph and receiver relays) in series. Thus they

work simultaneously. The second winding of these relays is a holding winding. The resistors wired in parallel with the windings serve for maintaining the prescribed operating values of the relays. From the diagram it can be seen that relay contacts R 16 and R 17 have zero potential. From here on therefore every mark impulse (Stromschritt) appears as zero potential, since the relays operate with all mark impulses which follow in the transmission of the messages. The impulse complexes of the two transmitted messages are held by the two relays in two separate channels. One channel (from oscillograph relay R 16) leads to the Braun tube which serves for checking and adjustment. The other channel (from receiver relay R 17) finally ends in the teleprinters. For operational control of the tube and relay circuits in the receiver amplifier the meter in the control part is connected to the various circuits (to measure voltage drop) by means of switches as shown in the diagram.

The two channels lead into the control part to switch U 42. From the transmitter to be received the telegraphic impulses may be sent either Mark (+) or Space (-). But since in the apparatus transmissions are only worked over in Mark current, there must be a possibility of changing messages in Space current (Ruhestrom) into Mark current (Arbeitsstrom). This may be done using switch U 42. How, is obvious from the diagram. The switch has three positions: +, Test, -. In "test" position the impulses delivered by the receiver are switched out and the test-sender switched in instead. The "test" procedure is described later.

First we shall follow further the channel from R 17, leading to the teleprinters. From switch U 42 it continues via switch U 44 ("Ready-On") (which permits interrupting the channel) to the impulse disc in the mechanical part. In the diagram the impulse disc is shown as an unwound ribbon. Both on the left and on the right sides it has copper segments. Over both sides runs a pair of brushes which connects the segments associated to the left side with those associated to the right side. The telegraphic impulses come to segments of the left side which lie opposite those on the right side designated 1a - 5a and 1b - 5b. These segments correspond to the twice five mark and space steps of the single letters or signs of the two transmissions. Now if the speed of revolution of the brush is in harmony with the speed of the transmitter (synchronization), the brush will always be on a segment when a mark or space is sent. Hence, the first impulse of the first message must fall on segment 1a, the second impulse of message I on segment 2a, etc., then the five impulses of message II fall correspondingly on the segments 1b - 5b (Phase synchronization). Adjustment to phase synchronization is described below. Segments 1a -5a and 1b - 5b are all connected and lead to tube R 51. The grid bias of this tube is so negative that practically no plate current can flow. But since every mark impulse appears as zero potential, the grid bias at the grid of the tube is zero volts with every mark impulse and plate current folws. The mark impulses now appear as strengthened mark impulses and reach the left side of the distributor disc.

Both sides are once more represented as unwound ribbons over which a pair of brushes rotates which is synchronized and in phase with the pair of brushes of the impulse disc. The left side of the distributor disc consists of a closed copper ring. The right side again has twice five segments, corresponding in position to segments 1a - 5a and 1b - 5b of the impulse disc. These are designated a_1 and a_5 and b_1 - b_5. Segments a_1 - a_5 lead to Storer 1, segments b_1 - b_5 lead to storer 2. Since the

brushes of the impulse-disc are synchronized with those of the distributor-disc, here again the brush is always on a segment when a mark or space is transmitted. Hence the distributor-disc separates the individual impulses of the one message from those of the other, assuming there is synchronization and phasing with the transmitter, and it sends them through the storers to the two teleprinters. The choke condensor in each line serves for suppression.

In the storer each impulse produced by a mark works through the distributor disc (a_1 - a_5 or b_1 - b_5) to operate an impulse relay (R 1 - R 5). From the diagram it is clear that a relay once operated is held automatically by the second winding (holding winding). The chokes, resisters and condensers there likewise serve for spark suppression etc. Now when a letter or sign of the message is stored in the five relays of the storer, the teleprinter finds closed circuits when it feels the storer through the operated relays, which really correspond to Mark impulses. The teleprinter gets the order to feel through the start-impulse. the start-impulse originates on the right side of the impulse-disc. There there are two segments marked S_1 and S_2. They lie behind the associated impulse segments 1a - 5a and 1b - 5b. Opposite on the left side lie segments with zero potential. The circuit from segment S_2 to storer 2 can be followed. In storer 2 the path leads via relay contact r 9/1 or via switch U 50 to the grid of tube Rö 6. The grid bias here is once more so high that practically no plate current flows. If the pair of brushes hits Start-segment S_2, the grid of tube Rö 6 receives zero potential and plate current flows. The relay R 6 in the plate circuit operates. Contact r 6/I switches + 60v to the coupling magnet in the teleprinter. With this the sender shaft makes one revolution and operates the sender contacts through the cams. The teleprinter, in contrast to ordinary teleprinters, has individual leads from the sender contacts leading to the storers. There the circuits are closed or not closed according to the stored letter so that the receiver magnet in the teleprinter receives mark or space through the sender in the teleprinter. From this combination results the printing of the letter. Once this procedure is finished, the storer must be cleared again to be free for the following letter. The origin of this procedure is likewise to be found on the impulse-disc. On the right side od the impulse-disc are two more segments L_1 and L_2. Opposite are segments with zero potential. In the diagram the path from the clearing segment L_2 to storer 2 may be followed. In the storer it goes via relay contact r 9/II or switch U 50 to tube Rö 8 which has the same grid bias as start-tube Rö 6. If the pair of brushes of the impulse disc hits the clearing segment, the grid of Rö 8 becomes zero volts, plate current flows and relay R 8 operates. Through the five contacts of this relay current supply to the individual holding windings of impulse relays R 1-5 is interrupted. These relays become without current, drop, and the storer is ready for new storage. The circuits of the tubes and relays are connected by selector switch to the meter in the control part and checked by this. The operating voltages for the teleprinters are also provided through the storers. Switching in is by the control part by means of switches U 45 and U 46; the storer and the teleprinter are switched out when relay R 10 is switched in. Glow lamps Gi 22 and Gi 23 serve for controls. Current supply for holding windings of the impulse relays R 1-5 passes first through the coil of relay R 9. Contacts r 9/I and

r 9/II connect the start and clearing segments to thegrids of the appropriate tubes. Hence, a start or stop impulse can only be effective if at least one impulse out of a group of five has been stored since only then is relay R 9 operated. For some types of transmission it is essential that starting ensue regularly without regard to any storing. For this purpose switch U 50 is operated. In this way the contacts of R 9 are bypassed.

The channel starting with oscillograph relay R 16 goes from switch U 42 in the control part to switch U 43, where it can be interrupted by operating this switch, and from there to the mechanical part to the deflection system (Ablenksystem) of the Braun tube. The deflection system consists of 4 coils mounted on a common ring shaped core. This rotates synchronously with the brushes of the discs around the Braun tube. As evident from the diagram, two coils wired in parallel of the deflection system constantly receive dc from the 12 volt stage which is very carefully smoothed for this purpose. If this system now rotates, a circle appears on the screen of the Braun tube. The diameter of the circle is adjusted at resistor W 326. Current is introduced into these coils via brushes B 55 and B 57. The impulses from the receiver amplifier reach the other pair of coils wired in series via resistor W 327 and then on through brush B 56. Since the Mark impulses have zero potential a further deflection of the cathode rays ensues throhgh the second pair of coils. On the screen of the tube mark impulses appear as rectangular deflections of the basic circle. The height of the deflection depends upon the setting of resistor W 327. The phase-signal which occurs regularly in the sending of the messages must necessarily appear on the fluorescent screen, at first in any position whatsoever. If there is synchronism with the transmitter, i.e. If the impulses of the two messages actually strike the corresponding segment of the impulse and distributor discs, the phase-signal will appear at a definite point on the screen. This point is marked by the "limit sign" (Begrenzungszeichen). This likewise has its origin on the right side of the impulse disc. There is another segment B. Opposite on the left side of the impulse disc lies a segment which is on zero potential through switch U 43 in the control part. Segment B leads to resister W 327. If the brush of the impulse disc hits segment B, zero potential is transmitted to resister W 327, i.e. the resister is partially shonted, as shown by the diagram. In this way the voltage is increased and on the screen appears an additional deflection (the limit sign) as long as the brush touches segment B.

The driving motor consists of two parts, the dc motor with shunt wiring and the tone frequency generator. The armature current can be watched on the meter in the control part by using a switch in the receiver amplifier. (voltage drop at resister W 330). Through a set of gears the brushes of the discs of the deflection system and the test sender are driven. The frequency required for synchronization is taken off from the synchronization amplifier. As shown by the diagram, the synchronization amplifier has a coarse setting for adjusting the frequency which consists of a stage-switch which can switch fixed condensers on or off. These lie in series with the condensers (Kapazität) C 112 and C 101. For fine setting there is a variable condensor. As inductance the primary winding of transformer U 5 is used. The frequency is preamplified in a second tube and then reaches the push-pull final stage (?) (Gegenkontakt-Endstufe). From there it is conducted to the motor in the mechanical

part. The individual circuits of the tubes are connected for control purposes by switches mounted in the receiver amplifier to the meter in the control part.
For securing phase synchronism there are two more switches U 4 and U 5 in the synchronization amplifier. When switch 4 is operated the condenser C 112, which is normally in series, is shorted. This lowers the frequency and the speed of the motor is reduced. On the screen the image of the phase-signal wanders to the left. When switch U 5 is operated, condenser C 101 is connected as supplement to condenser C 112 and the set condensers. The frequency becomes higher and the motor runs faster. The phase-signal wanders to the right. The switches are operated until the phase-signal has moved to the marked position.
To neutralize variations in speed automatically there is a device which makes it possible to influence the speed of the motor directly by the phase-signal from outside. On the right side of the impulse disc in the lower part are three more segments F, V and R. Opposite lies a segment which receives the telegraphic signals from the receiver amplifier as zero potential. To the three segments correspond three tubes RÖ 18 - RÖ 20 located in the regulating device in the receiver amplifier. The grid voltage is again so negative that practically no plate current flows. If one of the segments receives zero potential through the brush, the bias at the grid of the associated tube becomes zero volt. The relays lying in the plate current circuit of the tubes operate and influence the condenser of the resonant circuit (Schwingkreis) in the synchronization amplifier. When there is synchronism the mark impulse of the phase-signal progresses so that during the period of the mark impulse segments F and V are touched by the brush. Then contact r 18/I and contact r 19/I transfer. This brings no change since contact r 19/I supplements contact r 18/I. If all three segments are touched, the condensor (Kapazitat) C 112 lying in series is shorted. This occurs through contact r 20/I via contact r 18/I. Hence, if segment R is likewise touched, the machine runs too fast. Due to the brief increase in capacity the machine drops back a bit. If the machine is too slow and in consequence during the mark impulse only segment F is touched, the normally shorted Condensor C 101 becomes effective by the transfer of ontact r 18/I. The frequency becomes momentarily higher and the machine is accelerated. The plate current circuits of the three tubes are reconnected by means of switches to the meter in the control part for checking purposes.

In the mechanical part is still another disc: the test-sender. It serves for testing the entire apparatus including the teleprinter without the receiver. In the diagram the test-sender is represented as an unwound ribbon. The left side consists of a closed copper ring, the right side is made up of copper segments of uniform size alternating with insulating sections of the same size. The copper segments are connected with the copper ring. Brushes pass over both sides. The side with the segments receives the frequency from the synchronization amplifier through the brush. From the left side the scanned frequency passes to switch U 42 in the control part. The number of the segments on the right side yield at the specified speed a combination of impulses which permits teleprinter 1 to print Y and teleprinter 2 to print R.. If switch U 42 is put on center (testing - Prüfen), the impulses of the test-sender, which are shorted in the positions + and – , are connected to the input terminal of the receiver amplifier. The resister W 324 reduces the voltage of the impulses to the proper input voltage for the receiver amplifier.

Switch U 41 in the control part, designated "Örtlicher Gleichlauf", serves to check the local synchronization. By this is understood the synchronization of the machine with the frequency with which the machine is supposed actually to run, which is produced by the synchronization amplifier. If switch U 41 is operated, all impulses are cut off from the channel leading to the Braun tube. On the other hand the Braun tube receives the frequency of the synchronization amplifier and the frequency supplied by the tone frequency generator of the driving machine (motor ?). From the figure which arises on the fluorescent screen through this mixture of frequencies the state of local synchronization can be determined. In the control part is also a Netztrafo (power transformer) which supplies heater voltages for the various tubes. The heater leads and power leads for 220 v ac (feed leads) and the motor leads are not shown in the diagram.

Operating rules for apparatus 1313.

Before the apparatus is connected to the 220 v ac power line see that the automatic safety devices at the back of the apparatus are switched off. Moreover, the main switch 2 in fig. 6 must be on "AUS". When the apparatus has been grounded and the connection to the local power supply made via the cables supplied for the purpose, the type of voltage must be checked. For this test there is a glow lamp "Spannungsart" (type of voltage) on the back of the apparatus.

both electrodes of the lamp must glow. If only one electrode glows, the line has dc current and can not be used.
After the type of current has been ascertained, both safety devices are switched in and the current of the line is tested at instrument 1 of fig. 6. The power voltage must be 220 v ac + 10%. If these conditions are fulfilled the apparatus is ready for use.
For operation the following instructions are valid:
1. Adjust the remote transmitter in the radio receiver clean and as free from interference as possible with little volume.
2. Determine type of operation and speed of the remote transmitter by known rules.
3. Set switch 11 in fig. 6 for the type of operation as determined.
4. With knob 5 of fig. 5 make the coarse tuning of the synchronization frequency corresponding to the ascertained speed of the remote transmitter.
Fine tuning will be made later.
5. Switch 3 (Stufe 1) is set on "aus" (off) corresponding to fig. 6, likewise switch 4 (Stufe 2).
6. Set switch 9 on "Fernschreib" (teleprinter-ready).
7. Set switch 7 horizontal.
8. Switch 1 in fig. 2 on "Motor-Aus" (motor off).
9. Turn down input amplitude by means of potentiometer 2 in fig. 3.
10. Switch apparatus on with switch 2 in fig. 6 and allow a short time (2 minutes) for warming up.
11. Using knobs 4 and 5 of fig. 2 tune brilliance and sharpness of the spot in the Braun tube. Excessive brilliance shortens the life of the tube, hence, select a brilliance as low as consistent with good operation.
12. Set switch 4 in fig. 2 on "Motor - Ein" (motor - on).
13. Check local synchronization in the Braun tube using switch 10 of fig. 6 and adjust (tune) using knob 5 in fig. 2.
14. Increase input amplitude using potentiometer 2 in fig. 3 till perfect signals can be seen on the fluorescent screen of the Braun tube.
15. Adjust synchronization frequency at 1 Fig. 5 till phase-signal appears in the proper position on the screen. The phase-signal must not wander.
16. Using switch 2 in fig. 5 secure proper phasing of the apparatus.
17. Set switch 9 Fig. 6 on "Fs-Ein" (Telegraphy - on).

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1. Adjust the remote transmitter in the radio receiver clean and as free from interference as possible with little volume.
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3. Set switch 11 in fig. 6 for the type of operation as determined.
4. With knob 3 of fig. 5 make the coarse tuning of the synchronizing frequency corresponding to the ascertained speed of the remote transmitter.
Fine tuning will be made later.
5. Switch 1 (Stufe 1) is set on "aus" (off) corresponding to fig. 6, likewise switch 8 (Stufe 2).
6. Set switch 9 on "FS-bereit" (teleprinter-ready).
7. Set switch 7 horizontal.
8. Switch 6 in fig. 2 on "Motor-Aus" (motor off).
9. Turn down input amplitude by means of potentiometer 2 in fig. 3.
10. Switch apparatus on with switch 2 in fig. 6 and allow a short time (2 minutes) for warming up.
11. Using knobs 2 and 3 of fig. 2 tune brilliance and sharpness of the spot in the Braun tube. Excessive brilliance shortens the life of the tube, hence, select a brilliance as low as consistent with good operation.
12. Set switch 4 in fig. 2 on "Motor - Ein" (motor - on).
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17. Set switch 8 Fig. 6 on "FS-Ein" (Teleprinter - on).

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2. Determine type of operation and speed of the remote transmitter by known rules.
3. Set switch 11 in fig. 6 for the type of operation as determined.
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Fine tuning will be made later.

5. Switch 3 (Stufe 1) is set on "aus" (off) corresponding to fig. 6, likewise switch 4 (Stufe 2).
6. Set switch 9 on "FS-bereit" (teleprinter-ready).
7. Set switch 7 horizontal.
8. Switch 2 in fig. 2 on "Motor-Aus" (motor off).
9. Turn down input amplitude by means of potentiometer 2 in fig. 3.
10. Switch apparatus on with switch 2 in fig. 6 and allow a short time (2 minutes) for warming up.
11. Using knobs 2 and 3 of fig. 2 tune brilliance and sharpness of the spot in the Braun tube. Excessive brilliance shortens the life of the tube, hence, select a brilliance as low as consistent with good operation.
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15. Adjust synchronization frequency at 1 Fig. 5 till phase-signal appears in the proper position on the screen. The phase-signal must not wander.
16. Using switch 2 in fig. 5 secure proper phasing of the apparatus.
17. Set switch 9 Fig. 6 on "FS-Ein" (Teleprinter - on).

18. After local synchronization and correct phasing have been established set selector switch 1 of fig. 3 on "M". The index of instrument 8 fig. 6 must stand in the red field. This requirement is met by using knob 5 in fig. 2. While doing this the local synchronization must be watched in the Braun tube.
19. According to the operating position switch in storers 1 and 2 using switches 3 and 4.
20. Set switch 1 in the storers on "Dauerstart-Aus" (permanent start - off) according to Fig. 4. Special directions are issued for this.
21. During operation constantly watch the receiver status at the receiver, the local synchronization of the apparatus and the phasing in the Braun tube.
22. In case of brief severe disturbances throw switch 9 fig. 6 to "FS-bereit" (Teleprinter - ready). Switch back to "FS-Ein" (teleprinter - on) at once and watch point (spot ?) 21.
23. If there is any suspicion that the teleprinter is not printing correctly check the apparatus throughout using switch 11 in fig. 6. Machine 1 then prints Y when the potentiometer 2 of fig. 3 is turned on full and machine 2 prints R.
24. Have any troubles remedied only by approved personnel.

Weights and measurements.
Weights:

Frame without inserts	72 kg
Mechanical part	20.5
12 v stage	20.5
60 v stage	17.5
4 wooden boxes with cable	15.
Tube rectifier I	15 kg
Two storers	12
Tube rectifier II	11.5
Synchronization amplifier	10
Receiver amplifier	9.5
Control part	7
Total weight	210.5 kg
Weight of case	92. kg
Total shipping weight	302.5 kg

Size of case

Height	960 mm
Width	1545 mm
Depth	625 mm

Current consumption operating on 220 v ac line

i_N = ca 4 amp.

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R.W.P. 1946.